SELECTED PULMONARY DISORDERS

CHAPTER 32

Pneumonia

KEY TEACHING POINTS

- Many of the classic physical findings of lobar consolidation—diminished chest excursion, dullness, diminished breath sounds, bronchial breath sounds, and egophony—are accurate signs of pneumonia when present. Nonetheless, they appear in only the minority of patients with proven pneumonia; therefore their *absence* does not affect the probability of disease.
- In patients with cough and fever the presence of normal vital signs (i.e., temperature, pulse rate, respiratory rate, and oxygen saturation) decreases probability of pneumonia.
- The Heckerling scoring scheme combines five independent findings of pneumonia (tachycardia, fever, crackles, diminished breath sounds, and *absence* of asthma) and greatly increases the clinician's diagnostic accuracy for pneumonia.
- The CURB-65 score combines five findings to accurately predict the prognosis of patients with pneumonia, information that becomes essential when making decisions about triage of patients.

I. INTRODUCTION

Like most of the pulmonary examination, the traditional findings of lobar pneumonia were described in 1819 by Laennec, who wrote that clinicians using his newly invented stethoscope could detect acute pneumonia "in every possible case."[1] According to traditional teachings, the earliest findings of pneumonia are crackles and diminished breath sounds, followed by dullness to percussion, increased tactile fremitus and vocal resonance, and bronchial breath sounds.[2]

II. CLINICAL SIGNIFICANCE

A. INDIVIDUAL FINDINGS

EBM Box 32.1 reviews the findings from more than 6000 patients presenting with acute fever, cough, sputum production, or dyspnea, all of whom underwent chest radiography (the diagnostic standard for pneumonia). The findings increasing probability of pneumonia, in descending order of their likelihood ratios (LRs), are asymmetric chest expansion (LR = 44.1), egophony (LR = 4.1), cachexia (LR = 4), bronchial breath sounds (LR = 3.3), oxygen saturation of less than 95% (LR = 3.1), percussion dullness (LR = 3), respiratory rate higher than 28/minute (LR = 2.7), crackles (LR = 2.3), diminished breath sounds (LR = 2.2), temperature higher than 37.8° C (LR = 2.2), and abnormal mental status (LR = 1.9).

The only finding decreasing the probability of pneumonia was the finding that all vital signs were normal (LR = 0.3). In many studies, wheezing was found more often in patients *without* pneumonia, primarily because the cause of the acute respiratory complaints in these patients was asthma, not pneumonia.[4,5,17,18]

B. LAENNEC VERSUS MODERN STUDIES

There are three reasons why the studies in EBM Box 32.1 contradict Laennec's assertion that physical diagnosis is the perfect diagnostic tool: (1) Patients diagnosed with pneumonia today include those with more mild disease than in Laennec's time, when the only available diagnostic standard was postmortem examination (i.e., his conclusions were drawn from patients with only the most severe disease). (2) Many traditional findings appear only after several days of illness, times when the modern clinician, already familiar with the chest radiograph, often examines patients in a more cursory fashion. In contrast, Laennec examined each of his patients diligently day after day, concluding that bronchial breath sounds and bronchophony usually appeared only after 1 to 3 days of hospitalization, and dullness to percussion appeared only after day 4.[1,19] (3) Antimicrobial medications probably alter the course of the physical findings. For example, in the preantibiotic era, fever usually lasted 7 days in patients with lobar pneumonia;[20] nowadays it usually lasts only 3 or 4 days.[21,22]

Even so, many great clinicians of the past tempered Laennec's enthusiasm and taught that auscultation was an imperfect diagnostic tool. Writing only 20 years after Laennec's treatise, Thomas Addison* stated it was high time "to strip the stethoscope of the extravagant and meretricious pretensions thrust upon it . . . and to state fairly what it will not, as well as what it will do. . . ."[23]

C. COMBINED FINDINGS

Combining findings improves the accuracy of bedside examination. One of the best models, validated in four different populations[4,15] scores one point for each of the following five findings: (1) temperature higher than 37.8° C, (2) heart rate more than 100/minute, (3) crackles, (4) diminished breath sounds, and (5) *absence* of asthma. EBM Box 32.1 shows that a score of 4 or 5 argues compellingly *for* pneumonia (LR = 8.2), whereas a score of 0 or 1 argues *against* pneumonia (LR = 0.3), which in some groups of patients may reduce the probability of pneumonia enough that a chest radiograph becomes unnecessary (e.g., in patients presenting to a community

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*Thomas Addison, the discoverer of adrenal insufficiency, was also a recognized master of percussion and auscultation.

EBM BOX 32.1
*Pneumonia**

Finding (Reference)[†]	Sensitivity (%)	Specificity (%)	Likelihood Ratio[‡] if Finding Is	
			Present	Absent
General Appearance				
Cachexia[3]	10	97	**4.0**	NS
Abnormal mental status[4,6]	12-14	92-95	1.9	NS
Vital Signs				
Heart rate >100/min[3-11]	12-65	60-96	1.8	0.8
Temperature >37.8° C[3-14]	16-75	44-95	2.2	0.7
Respiratory rate >28/min[5-7,13]	7-36	80-99	2.7	0.9
Oxygen saturation <95%[8,13,14]	33-52	80-86	**3.1**	0.7
All vital signs normal[5,8,11,15,16]	3-38	24-81	**0.3**	2.2
Lung Findings				
Asymmetric chest expansion[3]	5	100	**44.1**	NS
Chest wall tenderness[12]	5	96	NS	NS
Percussion dullness[3-5,17,18]	4-26	82-99	**3.0**	NS
Diminished breath sounds[4,5,9,10,17,18]	7-49	73-98	2.2	0.8
Bronchial breath sounds[4]	14	96	**3.3**	NS
Egophony[3-5]	4-16	96-99	**4.1**	NS
Crackles[3-6,9,10,12,17,18]	19-67	36-96	2.3	0.8
Wheezing[4-6,9,12,17,18]	10-36	50-86	0.8	NS
Diagnostic Score[4,15]				
0 or 1 findings	7-29	33-65	**0.3**	—
2 or 3 findings	48-55	—	NS	—
4 or 5 findings	38-41	92-97	**8.2**	—

*Diagnostic standard: For *pneumonia*, infiltrate on chest radiograph.
†Definition of findings: For *all vital signs* normal, temperature <37.8° C, pulse ≤100/min, respirations ≤20,[5,8,11,15,16] and oxygen saturations >95%;[16] for Heckerling *diagnostic score*, the clinician scores one point for each of the following five findings that are present: temperature >37.8° C, heart rate >100/min, crackles, diminished breath sounds, and *absence* of asthma.
‡Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.
NS, Not significant.
Click here to access calculator

PNEUMONIA
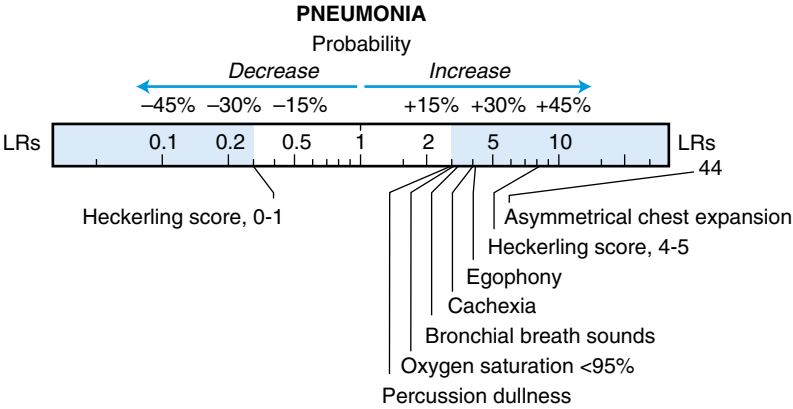
Probability

office with cough, in whom the probability of pneumonia is 10% or less, a score of 0 or 1 reduces the probability of pneumonia to 3% or less).

D. PNEUMONIA AND PROGNOSIS

In studies of immunocompetent adults hospitalized with community-acquired pneumonia, the 30-day mortality rate is 4% to 15%. Of the individual findings that predict an increased risk of death (EBM Box 32.2), the most compelling ones are hypotension (LR = 7.6) and hypothermia (LR = 3.5).

Several different scoring schemes combine bedside findings to predict mortality in patients with pneumonia. One of the best validated is the **Pneumonia Severity Index**,[51] which unfortunately has the disadvantage of requiring knowledge of 20 different clinical variables, making it difficult to recall and apply at the bedside. A much simpler rule is the *CURB-65* score, based on five prognostic variables[†] identified decades ago by the British Thoracic Society:[32] (1) confusion, (2) blood urea nitrogen (BUN) levels greater than 19 mg/dL (>7 mmol/L), (3) respiratory rate of 30 breaths/minute or higher, (4) hypotension (i.e., diastolic blood pressure ≤60 mm Hg or systolic blood pressure ≤90 mm Hg), and (5) age 65 years or older. The presence of three or more of these CURB-65 variables is associated with increased hospital mortality (LR = 2.6 for three findings, LR = 5.9 for four findings, and LR = 11.1 for five findings; see EBM Box 32.2), whereas the absence of all CURB-65 variables is associated with decreased hospital mortality (LR = 0.2 for 0 findings).

The CURB-65 score requires knowledge of the patient's BUN, which may not be immediately available to office-based clinicians. Related scores that omit laboratory values have also been studied, although less extensively so: a CRB-65 score of 0 (i.e., a score of 0 indicates the patient is younger than 65 years and lacks confusion, tachypnea, and hypotension) decreases the probability of mortality (LR = 0.1), and a CRB score of 2 or higher (i.e., two or more of confusion, tachypnea, and hypotension) increases probability of death (LR = 5.0).[26,27,32,33,38,52-54]

[†]CURB-65 is an acronym for Confusion, Urea, Respiratory rate, Blood pressure, and Age ≥65 years.

EBM BOX 32.2

*Pneumonia: Predictors of Hospital Mortality*

Finding* (Reference)	Sensitivity (%)	Specificity (%)	Likelihood Ratio† if Finding Is	
			Present	Absent
General Appearance				
Abnormal mental status[24-28]	48-65	70-87	2.7	0.6
Vital Signs				
Heart rate >100/min[24]	45	78	2.1	NS
Systolic blood pressure <90 mm Hg[25,29-31]	11-41	90-99	**7.6**	0.8
Hypothermia[25,30]	14-43	93	**3.5**	NS
Respiratory rate >30/min[25,26,32-34]	41-85	63-87	2.1	0.6
Oxygen saturation <90%[35,36]	18-52	75-96	2.8	NS
CURB-65 Prognostic Score[37-50]				
0 findings	0-16	41-92	**0.2**	—
1 finding	3-38		0.5	—
2 findings	17-51		NS	—
3 findings	13-61		2.6	—
4 findings	4-35		**5.9**	—
5 findings	1-12	99-100	**11.1**	—

*Definition of findings: For *hypothermia*, body temperature <36.1° C[25] or <37.0° C;[30] for *CURB-65* prognostic score, the clinician scores one point for each of the following findings that are present: confusion, BUN >19 mg/dL, respiratory rate ≥30/min, low blood pressure (either systolic blood pressure ≤90 mm Hg or diastolic blood pressure ≤60 mm Hg), and age ≥65 years.
†Likelihood ratio (LR) if finding present = positive LR; LR if finding absent = negative LR.
NS, Not significant.
Click here to access calculator

PNEUMONIA: PREDICTORS OF MORTALITY
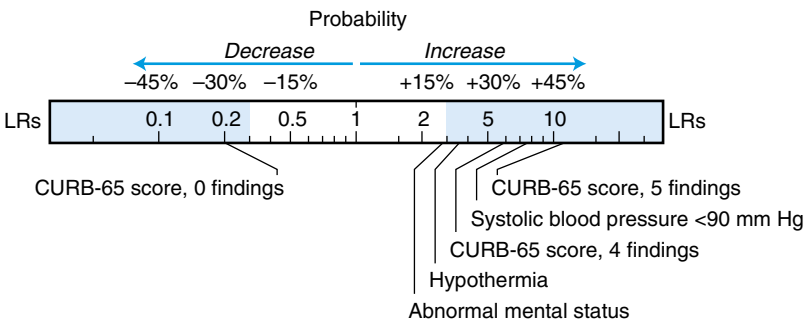
E. HOSPITAL COURSE

Among survivors of pneumonia, abnormalities of the vital signs—fever, tachycardia, tachypnea, and hypotension—usually become normal within 2 to 4 days.[21,22] After this occurs, subsequent clinical deterioration is rare, and fewer than 1% of patients will require subsequent intensive care, coronary care, or telemetry monitoring.[21] If patients are discharged from the hospital before normalization of vital signs, there is an increased risk of readmission and death.[55-57]

The references for this chapter can be found on *www.expertconsult.com.*

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